REPORTS FROM BREAKOUT SESSIONS
Breakout Report 1:
Electrical Trade and Specialty
Job Tasks Presenting High Risk for Developing WMDSs

The Electrical Trade and Specialty Breakout Session added the following three jobs to the list of jobs:

- Install underground service
- Install switch gears
- Residential wiring

In addition, the group identified two risk factors for the first two jobs. *Installing underground service* and *installing switch-gears*, which were described to have many high-risk issues.

Participants changed the hazard rank for each of the following tasks:

- *Connect fixture to ceiling or wall* was upgraded from the Moderate-risk to High-risk category.
- *Bend, align, and position conduit* was upgraded from the Moderate-risk to High-risk category.
- *Carry materials to work location* was upgraded from the Moderate-risk to High-risk category.
- *Connect wires* was downgraded from the High-risk to Moderate-risk category.
- *Bend wire to proper location* was downgraded from the Moderate-risk to Low-risk category.

As a result of this hazard ranking, six tasks were in the High-risk category, and two tasks were in the Moderate-risk category (see Table E-2 in Electrical Trade and Specialty, Breakout Sessions).

Exposures, risk factors, affected body parts, and interventions were identified and discussed for the following five high-risk tasks: *attach raceway to wall or ceiling; lift and carry materials and equipment; cut, bend, align, and position conduit; position fixture;* and *pull conductors (cable and wire).*

Interventions

Many different interventions were discussed, including those that participants reported in current use, as well as some that were believed to have a future potential for use. A few examples of each are described below.

Interventions in Use:

- Sling with built-in grips for manual material handling (MMH), especially where larger material handling equipment cannot be used or is impractical.
- Reinforcement by foreman of correct way to use equipment to reduce exposure to biomechanical stressors.
- Improved mentoring of younger workers to increase the learning curve, so that experience (e.g., bending conduit) comes faster.
- Conduit bending equipment that allows the worker to work from a standing position, rather than from kneeling on the ground.

Potential Future Interventions:

- Changes in material packaging (e.g., size, weight, handles) for better handling.
- Packaging designed with attachments (i.e., couplings) to improve material handling of equipment and materials.
- Battery-powered, low-vibration cutting tools provided to reduce hand-arm vibration exposure.
- Development of a portable battery-powered bender for small diameter conduit.

REPORTS FROM BREAKOUT SESSIONS
Breakout Report 2:
Pipe Trade and Specialty
Job Tasks Presenting High Risk for Developing WMDSs

The Pipe Trade and Specialty Breakout Session added the following two jobs to the original list of jobs:

- *Install equipment* (e.g. heating, ventilation, and air conditioning [HVAC] equipment, rooftop units, pumps, chillers, boilers); and
- *Building site preparation* (e.g., planning and organizing work).

Participants added the following task to the original list:

Position pipe, and assigned a Moderate risk to the task.

The following job and task names were modified for brevity, or to better represent the work:

- *Install plumbing or process piping systems* replaced *install domestic water/sanitary/gas pipes* (installing piping systems).
- *Join pipes* replaced *weld, solder, braze, screw, and bolt pipes.*
- *Lift and carry materials* replaced *carry materials to work location.*

Participants changed the hazard rank for each of the following tasks:

- *Join pipes* was upgraded from the Moderate-risk to High-risk category.
- *Lift and carry materials* (including offloading at intermediate staging areas and point of use) was upgraded from the Moderate-risk to High-risk category.
- *Position fixtures* was downgraded from the High-risk to Moderate-risk category.
- *Attach fixtures* was downgraded from the High-risk to Moderate-risk category.

As a result of this task hazard ranking, six-tasks were in the High-risk category, and three tasks were in the Moderate-risk category (see Table P-2).

Interventions

Exposures, risk factors, affected body areas, and interventions were discussed for the following High-risk category tasks: drill holes/drive/shoot fasteners into ceiling; place hanger; lift and carry materials; and join pipe.

Interventions Needing Further Evaluation: Participants also considered whether the interventions discussed should be publicized at this time, or whether further work was necessary, such as evaluating the effectiveness of the intervention. The group decided there were universal recommendations that could apply to many tasks, and not just to the one under discussion.

Participants decided the following interventions needed further evaluation:

- Power tool vibration levels assessed. Results should be disseminated to contractors and tradespeople, so they can select and use tools that produce lower vibration levels.

- Neck pillow used to support the head during overhead work.
- Drill stand to hold rotary drills and other power tools during overhead work.
- Remote actuating devices for power tools, to activate them without use of a finger trigger.
- Guidelines for the weight and profile (e.g., size) of materials, e.g., NIOSH lifting guideline [1994]. If a guideline is recommended, what specifications are needed in terms of height of lift, type of coupling (e.g., cutout for hand grip, handle), etc.
- Material handling system developed in Japan (5 S's), which provides a comprehensive view of how building materials can be more efficiently organized and used on a job site.
- Properly fitting gloves.
- Shoulder guards (carrying materials on the shoulders can limit visibility).

Potential Future Interventions:

Interest was highest for addressing the following interventions:

- Improved construction material handling devices;
- Development of weight and profile guidelines for materials;
- Development of a stand for overhead drilling into concrete; and
- Improved hand tool design.

The following topics also generated lively discussion:

- Upstream engineering and design, particularly with hanger systems for piping and equipment;
- Importance of coordination and planning (e.g., interaction of the foreman and crew, task planning, and coordination with other trades and contractors); and
- Training for workers.

REPORTS FROM BREAKOUT SESSIONS
Breakout Report 3:
Sheet Metal Trade and Specialty
Job Tasks Presenting High Risk for Developing WMDSs

The Sheet Metal Trade and Specialty Breakout Session added the following three jobs to the original list:

- Demolition;
- Move material to and within job site; and,
- Detail work and field design, which can impact other activities that may involve hazards.

Participants added the following tasks to the original list:

- Welding;
- Cut and trim duct joints;
- Moving heavy equipment;
- Cut and remove duct sections; and,
- Assemble duct sections in the field.

As a result of this task hazard ranking, 10 tasks were in the High–risk category, and three tasks were in the Moderate–risk category (see Table SM–2, in Sheet Metal Trade and Specialty, Breakout Sessions).

Interventions

Exposures, risk factors, affected body areas, and/or interventions were discussed for the following tasks: *drill holes; screw or shoot into ceiling; connect duct to hanger or ceiling; place hanger; welding; cut and trim duct joints; moving heavy equipment;* and, *cut and remove duct sections.*

Interventions Discussed:

Tasks 1-4 involve overhead work. Considerable discussion ensued about supporting tools for overhead work. Everyone had heard of such supports, but no one had ever seen one used. It was questioned whether a reverse drill press would work with a roto-hammer, which is an important area to explore.

The discussion concerning interventions included the following concerns:

- Many interventions implemented in the sheet metal fabrication shops have been difficult to implement or maintain on a construction job site, because contractors and tradespeople have less control of their work environment outside the shop.
- The need for job site coordination and planning and stretching programs was universal.
- Participants reported that cordless (battery-operated) tools are reducing some repetitious hand activity.
- Greater attention to upstream design was discussed to eliminate WMSD risk factors (e.g., reduce the need to drill holes for overhead hanger systems).

- Genie™ and other powered person–lifts were reported to have had a positive effect at reducing exposures to biomechanical stressors reported to occur during the installation of duct and equipment at or near the ceiling.

Questions and Comments from Breakout Session 3

Jim Albers: Did you discuss how the innovations implemented in the shop can be transferred to the field, and whether training increases recognition of what needs to be done in the field?

Chris Warren: We do a great job in our shops because it's a controlled environment. If we take these ideas to a job site where there's a cooperative general contractor and owner, it's easy. At a job site where the culture and equipment are not there, it's different. I see the need for more cooperation from the owners, contractors, and unions. It sounds like in Washington and Oregon the union is proactive. They should be more involved in Wisconsin.

Steve Hecker: One area where changes are making their way out to the field is prefabbing and doing work at table height. Streimer Sheet Metal has sent worktables that originated in the shop to the site.

Phil Lemons: Kelly True gave the example of a duct assembly system built in the field that is now making its way back into the shop. So, the influence can move both ways. Sometimes the driver for change is quality rather than safety. The field might receive damaged duct from the shop, or duct that is improperly put together or in need of adjustment. That is an added cost. Safety improvements have come out of these concerns. We can't ignore the connection between safety and productivity. There are two drivers—the shop and field, working back and forth.

Tony Barsotti: Words of caution about shop pre-fabrication. It includes specialization. The history of the trades is increased specialization to increase productivity. This results in some people doing the same things longer and longer. Some piping fabrication shops are mini-sweatshops. It might help in the field, but we could just be shifting our exposures. That applies to outsourcing pre-fabrications, as well. Last year, we outsourced some heavy steel pedestals, and a young apprentice was killed in the pre-fabrication shop in material handling. He wasn't fully trained in the rigging.

FINAL SESSION
General Discussion

Cherie Estill: How can the three trades work together? For example, many are working in the same overhead areas. Could they use the same hangers, for instance?

Reinhard Hanselka: Communication is most important.

John Rosecrance: There's a need for communication within the trades too, about interventions. There are also applications from the automobile industry and other industries.

Chris Warren: The larger companies that have the capability to do design-build can get involved with the owner early in the project. Superintendents, engineers, and design-build people can work in the design mode much earlier. You can use Unistrut™ or cable in the concrete form, when it's poured and have the anchors already there, before you drill.

Scott Schneider: The National Institute for Occupational Safety and Health (NIOSH) has been looking at crossover technologies from the mining industry in putting in roof bolts. In addition, as with operators of heavy equipment in mining, there are similarities in construction. The mining industry has done more than we have; we can learn from them.

Kelly True: In some projects I've been involved in, they've established zones for routing the various utilities—electrical, mechanical, sheet metal, and piping trades. Sometimes one gets the right of way, and the rest coordinate around it. For example, on a utility pump, the lines that go to them have a prescribed length which dictates where the others have to route and run their utilities. That requires a lot of coordination up front. On larger base field activities, those who are coordinating the installation get together with the other trades. They look at their shop drawings and coordinate their layouts and routings to make sure they've identified interferences. There's less re-work, and you know where people are going to be. It's streamlined.

Charles Austin: We can see if there can be crossover for training materials, as well (e.g., like SMOHIT's welding chart). I found that other trades have similar hazards. If we're training on similar materials, then we can understand how that craft uses those materials, and what kind of work they do. As an industrial hygienist, I'm trying to learn how the construction crafts work together.

Tony Barsotti: Equipment made by Greenlee (primarily an electrical manufacturer) has spread to other trades, by people just noticing that it would work for them, as well. Material handling equipment developed for one could meet the needs of others. We need to have our needs better understood by manufacturers and vendors: the question of using scissor lifts for material handling—everyone is doing that. The manufacturers claim you can't modify that equipment, but you need

to get the material up in the air, as well as the people. It works well for almost everybody, without a perceived hazard in most cases. These needs can be addressed across trades and across different handling equipment.

Peregrin Spielholz: Some general contractors (GCs) in Washington are interested in moving higher up in the process. Safety and Health Assessment and Research for Prevention (SHARP) has arranged meetings with some architects and some of the largest contractors to develop guidelines for integrating ergonomics into the design. Another thing some GCs have discussed, at least on public projects, is to have ergonomics be required as a line item on the contract, so that it's built into the cost of the contract.

Joe York: We overlook coordination of training between the trades. Electricians do many of the same things we [pipe trades] do. A gentleman here teaches the OSHA 10. I have to have my people trained back in Michigan to teach that class. We have training centers around the state, so we could have other trades at our training facilities with our people and/or their people. They already do this at the bigger high-tech plants, like Intel. When Billy Gibbons teaches an ergonomics class, she has people from several trades. Unfortunately, the unions haven't come to that level.

Cherie Estill: This question is for contractors. If there's a new engineering change, what does it take to adopt that solution? How much research do you want to have seen? Do you have to have a study showing that it's less of a physical hazard, or do you have to know that somebody else is actually using it?

Chris Warren: If it works, use it. If the guys like it, use it. If the guy likes the safety glasses he's wearing, he'll wear them. If it's going to be easier on workers, I don't need a study to tell me it's worthwhile.

Cherie Estill: You're willing to give it an on-the-job trial?

Chris Warren: Unless it's very expensive.

Unidentified participant: As safety people, we don't always talk about this, but proactive contractors take on things that are more expensive. However, for most contractors, availability and money are the two biggest issues.

Billy Gibbons: From experience, I know it's a myth to think that if something costs money, it should work. A contractor can have the best equipment, but that doesn't guarantee that people will use it in the field. What's important is relationship: Who's presenting this tool? What's their motive? Are they your friend or foe? For example, take Ironworkers and the automatic rebar tier. Initially, they dismiss the automatic tier. But once you establish a relationship, walk it out to the field, give people time to try it, brainstorm with them, then they say, "Yeah, we could use it for people who are injured and keep them on the job" and other applications.

Scott Schneider: If it's complicated to use, people don't want it. If it takes more than 30 seconds to adjust, so that it's at

your height, that's a disincentive. It's also a disincentive if you have to go somewhere to get it. If the change will reduce the skill level, there will be resistance. People don't want to lose their skills or find them de–valued. Changing rebar tying from a hand operation to a mechanical operation is a tough sell. We have to be more careful about how we make that change, and if that change is really needed.

Patty May: In our company, we've rented the equipment before investing in it. We've found that safety often brings up productivity.

Cherie Estill: What do you expect of NIOSH?

Unidentified participant: There's always resistance. You can put out a tool for an injured worker or someone who can't do the job the typical way, and with enough promotion of that tool, more people will be using it—if they see the benefits for themselves. Perhaps NIOSH could partner with contractors to test these tools in the field and evaluate them.

Unidentified participant: Influence the contractors to try these new ideas. Workers don't know you exist. You need a publication to let them know you're there.

Unidentified participant: Lobby the tool manufacturers and look at how to change the packaging of construction materials.

Unidentified participant: Let the contractors know who you are. I thought you were a part of OSHA, and I wasn't interested in talking to you. Contractors associate you with regulatory activities, rather than research.

Laura Boatman: We need a clearinghouse or library where all this great work comes together, that we can easily access.

Billy Gibbons: If they know NIOSH is not OSHA, the next perception is "Be careful of those researchers; they'll suck all your time." There's a perception that we don't operate in real time and are more concerned about our own data collection. NIOSH needs to get better at field application research so the contractors will want us there, rather than being more focused on our classroom or data collection in a lab, so we can make it more applicable.

Chris Warren: I want to thank NIOSH for putting an agenda together and getting some tasks completed. What are we going to do with this stuff now? We've been talking about ergonomics for ten years, but we're still working on it, and in ten years we still will be. Do we get this group back together again, or new people, and recap what we've done and the way forward?

Cherie Estill: I don't know that we have a plan to get this exact group together or these trades, but that would be a good idea.

Unidentified participant: Go to the people. Get a team together, do your homework ahead of time, call some organizations, [and] set up time on the job site where you do nothing but observe. Talk to the workers and observe their work. You can't replicate conditions in a lab.

Zin Cheung: What level is the information targeted to? That's important, whether it's for the worker, or the contractor, or owner. Each project should have a clear target.

Cherie Estill: NIOSH's plan is to publish the conference proceedings with all the interventions. Our larger goal is to identify interventions that are already out there, but need to get out to everybody else. We'll develop two-page "tip sheets" that have the problem, the solution, productivity, and cost issues, and where to buy it, or how to make it. We'll collect them and make a tip sheet publication, and put each tip sheet on the NIOSH Web site. That's the best place we know to disseminate them. For tip sheets that are specific to a trade, we could go through SMACNA or SMOHIT and send one to each contractor.

The second area is ideas that haven't been tried that we could build ourselves and take to sites to try out. We'll do a few each year. If there are specific ideas that you think could be made into a tip sheet, please let me know.

Besides our Web site, there's the CPWR's <www.cpwr.com> and the Electronic Library of Construction Occupational Safety and Health (eLCOSH) <http://www.cdc.gov/niosh/elcosh/index.html>. They're trying to find all the information that exists that's particularly for workers.

Jim Albers: We plan to continue doing field investigations, and we will evaluate several interventions each year that look promising. We have limited resources for dissemination of information, but we can make sure trade associations—like the Associated General Contractors (AGC), SMACNA, and Mechanical Contractors Association (MCA)—get the materials we produce.

Scott Schneider: The Washington State Department of Labor and Industries is developing an ergonomic resource library of interventions. We'll be working with the Washington AGC to do something for the construction industry, maybe working with the eLCOSH. The question for me is not so much what's out there. It's not as if people don't know you can use a cart or a dolly. The question is what are the obstacles. Why isn't this intervention integrated into all of our safety programs? Just as people talk about guardrails on scaffolds, they should talk about making sure they have a level surface so people can use a dolly or cart. People don't know about some of the new equipment, but a lot of it is getting people to think about ergonomics as part of their daily activities.

Zin Cheung: The states have licensing boards. Can information pertinent to certain trades be spread through the licensing system?

Steve Hecker: I agree a lot is out there, and we have to overcome the barriers. There is a lot in Europe that we don't know how to get. NIOSH could take steps there.

Cherie Estill: I want to thank our three facilitators? Steve Hecker, Billy Gibbons, and Tony Barsotti, and the contractors and workers, or former workers, who came. Also, Jim Albers, Leslie MacDonald, and Yongku Kong (NIOSH). Thank you all for coming.

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APPENDICES

APPENDIX I

The 65 meeting attendees were drawn from the following organizations and contractors:

Trade Associations: Associated General Contractors; Mechanical Contractor's Association of Western Washington; Sheet Metal and Air Conditioning Contractors of North America

Electrical Contractors: Cupertino Electric (CA); Dickey Electric (OH); Frank Electric (CA); Helix Electric (CA); Rosendin Electric (CA); SASCO Electric (WA); Valley Electric (WA)

Mechanical Contractors: Cal-Air, Inc. (CA); Encompass Mechanical Services (CA, TX); Kinetics Group, Inc. (CA); Southland Industries (CA); Streimer Sheet Metal (OR); Triad Mechanical (OR); Tweet–Garot Mechanical (WI)

General Contractors: Hoffman Construction (OR); WG Clark Construction (WA)

Joint Labor–Management: Construction Safety Association of Ontario (Canada); IBEW-NECA Joint Apprenticeship Training (CA, OR); Sheet Metal Occupational Health Institute Trust (VA); Laborers' Health and Safety Fund (DC); South Bay Piping Industry Labor Management (CA)
Labor Organizations: California Building Trades Council; International Brotherhood of Electrical Workers; United Association of Plumbers and Pipefitters; Sheet Metal Workers' International Association

Universities: Purdue University (IN); University of California Berkeley (CA); University of California–San Francisco (CA); University of Iowa (IA); University of Massachusetts, (Lowell, MA); University of Oregon-Salem (OR)

Government: British Columbia Workers' Compensation Board (Canada); California OSHA Consultation Program (CA); California Health Evaluation System and Information Services, Department of Health Services (CA); National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention (Cincinnati, OH); Oregon OSHA Program Consultation (OR); Safety and Health Assessment and Research for Prevention (SHARP), Washington State Department of Labor & Industries (WA)

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